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STATEWIDE EMISSION INVENTORY OF NORTH DAKOTA

Raymond D. Fox, et al

GCA Corporation

Prepared for:

Environmental Protection Agency

August 1971

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STATEWIDE EMISSION INVENTORY of NORTH DAKOTA

by
Raymond D. Fox
Billy C. McCoy

Prepared by
GCA CORPORATION
GCA TECHNOLOGY DIVISION
Bedford, Massachusetts 01730

Contract No. 68-02-0041

August 1971

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16. Abstracts

The results of an emission inventory for the state of North Dakota are presented. The inventory was concerned with the following pollutants: particulates, sulfur dioxide, carbon monoxide, hydrocarbons and nitrogen oxides. The annual emission levels for each of these pollutants were established for each of these pollutants for each of the 53 counties in North Dakota, and for the four principal metropolitan areas: Bismark/ Mandam, Fargo/ West Fargo, Grand Folks, and Minot. In addition totals for each pollutant are presented for the two Air Quality Control Regions in North Dakota. The emission levels of each pollutant are presented for each geographic area by the following source categories: Stationary fuel combustion sources; Transportation sources; Solid waste disposal: and Process losses.

17. Key Words and Document Analysis. 17a. Descriptors

Air pollution
Emission
Inventories
Particles
Sulfur dioxide
Carbon monoxide
Hydrocarbons
Nitrogen oxides
Sources
Fuels
Combustion products
Transportation
Waste disposal
Processing

17b. Identifiers/Open-Ended Terms

North Dakota
Air Quality Control Regions
Particulates
Stationary sources

17c. COSATI Field/Group 13B

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I. INTRODUCTION

A. BACKGROUND OF PROGRAM

A primary purpose of the Federal Air Quality Act of 1967 was to provide for planning and control programs on a regional basis. More recently, the Environmental Protection Agency has required the preparation, adoption and submittal of implementation plans for meeting national ambient air standards by each of the states.

An important first step in implementation planning is the carrying out of an emissions inventory to determine the principal pollution sources in the state. The present report presents the results of an emissions inventory for the state of North Dakota.

B. DESCRIPTION OF PROGRAM

The study program is concerned directly with establishing annual emission levels for the following five pollutants:

Particulates
Sulfur Dioxide
Carbon Monoxide
Hydrocarbons, and
Nitrogen Oxides

The annual emission levels for each of these pollutants are established for each of the 53 counties in North Dakota as well as for the four principal metropolitan areas: Bismarck/Mandan, Fargo/West Fargo, Grand Forks, and Minot. In addition, totals for these pollutants are presented for the two Federal Air Quality Control Regions in North Dakota. These regions are No. 130 consisting of Cass County and No. 172 consisting of the remaining 52 counties. Figure 1 presents a North Dakota map which shows the geographic locations of these regions.

For each geographic area discussed above (region, county, city), the emission levels for each of the 5 pollutants are presented by source category. These categories are:

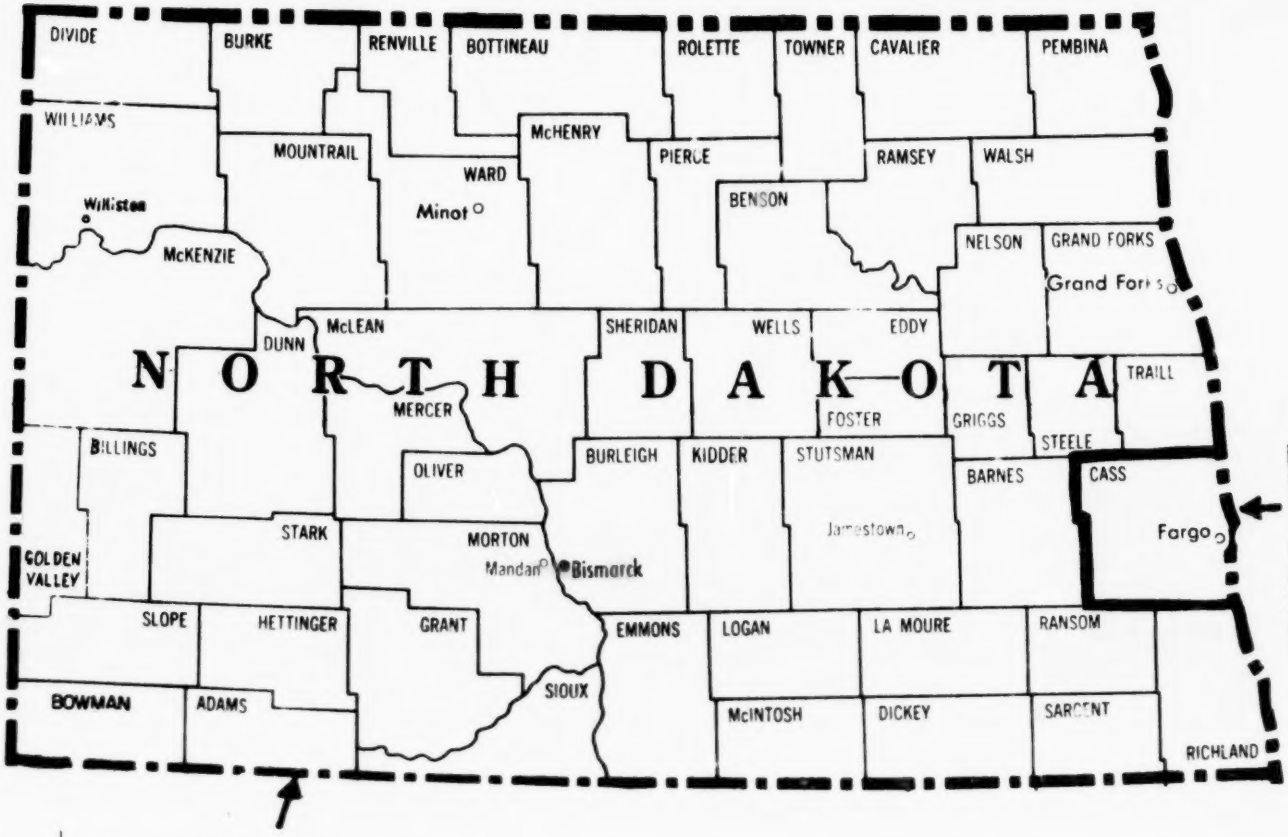

Figure 1. Boundaries of North Dakota Air Quality Control Regions.

1. Stationary Fuel Combustion Sources - These include power plants, as well as industrial, institutional, commercial, and residential facilities.

2. Transportation Sources - These include both gasoline and diesel-powered motor vehicles, aircraft and railroads. In addition, tractors, the major off-highway consumer of both distillate fuel oil and gasoline, are classified in this source category. Also included are evaporative losses from gasoline marketing.

3. Solid Waste Disposal - Municipal and private dumps which practice open burning, together with residential, commercial - institutional and industrial incineration and open burning comprise this source category. There are no municipal incinerators in North Dakota.

4. Process Losses - These include stone crushing and processing, various minerals industries, asphalt and concrete batch plants, meat packing and over 650 grain elevators spread throughout the state. Included here are evaporative losses at petroleum bulk storage terminals, solvent evaporation from surface coating operations, and solvent evaporation from dry cleaning.

C. USE OF THE INVENTORY

The data presented in this survey are not to be interpreted as absolute values. The pollutant emissions obtained should be considered as estimates to be used in defining the extent and distribution of air pollutant emissions in North Dakota. The data are accurate enough to be used in conjunction with ambient air quality measurements in the preparation of an implementation plan for meeting national ambient air standards.

II. SUMMARY

The results of the statewide emissions inventory program for North Dakota are summarized in Tables 1 through 6. Emissions from all pollutant source categories are presented and totalled for both of the Air Quality Control Regions as well as for the four principal urban centers; Bismarck/Mandan, Fargo/West Fargo, Grand Forks, and Minot. A general discussion of the results for each of the five pollutants of interest is presented in the following sections.

Both the computer program, which handled the source data, and the emissions summary tables on which the reduced data were to be presented, were based on fuels most commonly used throughout the nation. Hence, the only coal types shown in the computer printout and summary tables are anthracite and bituminous. However, North Dakota has enormous reserves of low-sulfur lignite coal, and coal-burning installations use this fuel almost exclusively. As a consequence, all references to coal use in North Dakota imply lignite coal.

A. PARTICULATES

1 The principal sources of particulate matter statewide are stationary fuel combustion and process losses, the former accounting for about 43 percent of the total and the latter about 53 percent. The process losses are due chiefly to grain elevator operations, but asphalt batching plants may pose local problems. The principal combustion source is coal-burning at steam electric power plants.

2. The source distributions for the two regions are markedly different. In Region 130, about 12 percent of the emissions result from combustion and 86 percent are due to processes, while in Region 172, these values are 50 percent and 46 percent, respectively. This is due chiefly to the lack of any large coal-burning steam electric power plants in Region 130.

3. Stationary fuel combustion and process losses constitute the major particulate sources for the four urban centers, but, as the table below indicates, the percentage distributions vary widely:

TABLE 1

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA

AIR QUALITY CONTROL REGION 130

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					FUEL ETC.	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	23	93	12	7	28	4,626	10^3 gal/yr
3. NATURAL GAS	12	0	12	5	46	1,235	10^6 ft.^{3}/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	9	0	10	4	34	3,001	10^3 gal/yr.
6. TOTAL	44	93	34	16	108		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	1,401	538	31	15	231	30,800	tons/yr.
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	47	127	0	10	190	6,335	10^3 gal/yr.
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0	0	
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	4	27	0	1	10	345	10^3 gal/yr.
5a. NATURAL GAS-AREA SOURCE	15	0	13	9	67	1,535	10^6 ft.^{3}/yr.
b. NATURAL GAS-POINT SOURCE	12	0	0	27	120	1,370	10^6CF ft.^{3}/yr.
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0	0	
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	2	0	2	1	9	750	10^3 gal/yr.
9. TOTAL	1,481	692	46	63	627		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	662	1,655	79	40	594	79,200	tons/yr.
3. DISTILLATE OIL	0	0	0	0	0	0	
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	0	0	0	0	0	0	
6. TOTAL	662	1,655	79	40	594		
D. TOTAL FUEL COMBUSTION	2,187	2,440	159	119	1,329		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	1,223	0		
B. POINT SOURCES	14,922	0	102	2	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	28	6	39	12	12	7,858	tons/yr.
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	126	8	668	236	47	15,716	tons/yr.
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	154	14	707	248	59	23,574	tons/yr.
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	120	72	37,246	5,220	3,733	364,448	10^3V-M/yr.
2. MOTOR VEHICLES-DIESEL	64	116	837	167	876	5,151	10^3 gal/yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	8	15	108	22	113	666	10^3 gal/yr.
2. GASOLINE	11	7	4,450	593	315	2,697	10^3 gal/yr.
C. AIRCRAFT	44	11	83	254	42		
D. RAILROADS	33	86	93	67	100	2,661	10^3 gal/yr.
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	397	0		
F. TOTAL TRANSPORTATION	280	307	42,817	6,720	5,179		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	1,188	0	0	0	0		
VI. GRAND TOTAL							
A. AREA SOURCE	1,730	541	43,573	8,227	5,612		
B. POINT SOURCE	17,001	2,220	212	85	955		
C. TOTAL	18,731	2,761	43,785	8,312	6,567		

TABLE 2

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA, CITIES OF FARGO AND WEST FARGO

AIR QUALITY CONTROL REGION 130

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulates	SO_x	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	6	25	3	2	7	1,230	10^3 gal./yr.
3. NATURAL GAS	12	0	12	5	46	1,233	10^6 ft.^{3}/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	2	0	2	1	10	846	10^3 gal./yr.
6. TOTAL	20	25	17	8	63		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	1,124	539	60	23	199	30,800	tons/yr.
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	7	18	0	1	26	876	10^3 gal./yr.
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0	0	
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0	0	
5a. NATURAL GAS-AREA SOURCE	15	0	13	9	66	1,531	10^6 ft.^{3}/yr.
b. NATURAL GAS-POINT SOURCE	12	0	0	27	120	1,370	10^6 ft.^{3}/yr.
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0	0	
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	1	0	1	0	2	212	10^3 gal./yr.
9. TOTAL	1,159	557	74	60	413		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	663	1,656	80	40	596	79,200	tons/yr.
3. DISTILLATE OIL	0	0	0	0	0	0	
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	0	0	0	0	0	0	
6. TOTAL	663	1,656	80	40	596		
D. TOTAL FUEL COMBUSTION	1,842	2,238	171	108	1,072		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	970	0		
B. POINT SOURCES	2,073	0	102	2	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	17	8	53	16	16	10,681	tons/yr.
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING	0	0	0	0	0	0	
1a. ON SITE-AREA SOURCE	0	0	0	0	0	0	
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	37	8	53	16	16	10,681	tons/yr.
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	53	212	17,916	2,468	1,610	161,360	10^3V-M/yr.
2. MOTOR VEHICLES-DIESEL	28	50	363	73	380	2,235	10^3 gal./yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	0	0	0	0	0	0	
2. GASOLINE	0	0	0	0	0	0	
C. AIRCRAFT	0	0	0	0	0	0	
D. RAILROADS	2	5	5	4	5	141	10^3 gal./yr.
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	276	0		
F. TOTAL TRANSPORTATION	83	267	18,284	2,821	1,995		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	438	0	0	0	0		
VI. GRAND TOTAL							
A. AREA SOURCE	601	318	18,368	3,825	2,168		
B. POINT SOURCE	3,872	2,195	242	92	915		
C. TOTAL	4,473	2,513	18,610	3,917	3,083		

TABLE 3

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA

AIR QUALITY CONTROL REGION 172

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR						
	Particulate	SO_2	CO	HC	NO_x	Quantity	Unit
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	396	1,596	198	119	475	79,174	10^3 gal./yr.
3. NATURAL GAS	68	7	71	28	267	7,113	10^6 ft.^{3}/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	157	0	166	66	590	51,390	10^3 gal./yr.
6. TOTAL	621	1,598	435	213	1,332		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	8,585	2,600	288	128	1,590	221,992	tons/year
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	792	2,130	10	158	3,170	105,665	10^3 gal./yr.
b. DISTILLATE OIL-POINT SOURCE	209	3,291	3	42	734	27,921	10^3 gal./yr.
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	17	115	0	2	44	1,449	10^3 gal./yr.
5a. NATURAL GAS-AREA SOURCE	84	2	78	52	385	8,837	10^6 ft.^{3}/yr.
b. NATURAL GAS-POINT SOURCE	39	1	8	77	323	4,319	10^6 ft.^{3}/yr.
6. PROCESS GAS-POINT SOURCE	8	4,485	9	4	46	923	10^6 ft.^{3}/yr.
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	39	0	41	16	148	12,848	10^3 gal./yr.
9. TOTAL	9,773	12,624	437	479	6,440		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	38,353	55,916	2,841	2,864	66,153	4,733,607	tons/year
3. DISTILLATE OIL	1	9	0	1	13	434	10^3 gal./yr.
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	3	0	0	7	35	350	10^6 ft.^{3}/yr.
6. TOTAL	35,357	55,925	2,841	2,872	66,201		
D. TOTAL FUEL COMBUSTION	48,751	70,147	3,713	3,564	73,973		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	13,955	0		
B. POINT SOURCES	26,647	10,319	50,290	15,260	3,391		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	203	44	290	87	87	58,044	tons/year
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	929	58	4,934	1,741	348	116,090	tons/year
b. ON SITE-POINT SOURCE	1	0	4	0	0	140	tons/year
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	1,133	102	5,228	1,828	435	174,274	tons/year
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	1,062	643	281,346	40,856	34,376	3,216,840	10^3 V-M/yr.
2. MOTOR VEHICLES-DIESEL	568	1,023	7,385	1,477	7,726	45,445	10^3 gal./yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	318	572	4,133	827	4,324	25,434	10^3 gal./yr.
2. GASOLINE	425	258	170,082	22,678	12,047	103,080	10^3 gal./yr.
C. AIRCRAFT	118	28	193	583	110		
D. RAILROADS	555	1,444	1,555	1,111	1,666	44,439	10^3 gal./yr.
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	3,462	0		
F. TOTAL TRANSPORTATION	3,046	3,968	464,694	70,994	60,249		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	18,810	0	0	0	0		
VI. GRAND TOTAL							
A. AREA SOURCE	24,524	7,800	470,482	87,216	65,719		
B. POINT SOURCE	73,843	76,736	53,443	18,385	72,329		
C. TOTAL	98,367	84,536	523,925	105,601	138,048		

TABLE 4

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA, CITIES OF BISMARCK AND MANDAN

AIR QUALITY CONTROL REGION 172

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulate	SO_x	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	5	19	2	1	6	963	10^3 gal./yr.
3. NATURAL GAS	19	1	20	8	49	1,956	10^6 ft.^{3}/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	2	0	2	1	7	726	10^3 gal./yr.
6. TOTAL	26	20	24	10	62		
B. COM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	0	0	0	0	0	0	
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	6	13	0	1	19	635	10^3 gal./yr.
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0	0	
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0	0	
5a. NATURAL GAS-AREA SOURCE	21	1	21	9	110	2,135	10^6 ft.^{3}/yr.
b. NATURAL GAS-POINT SOURCE	1	0	0	6	26	299	10^6 ft.^{3}/yr.
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0	0	
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	1	0	1	0	2	182	10^3 gal./yr.
9. TOTAL	31	14	22	16	157		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	0	0	0	0	0	0	
3. DISTILLATE OIL	0	0	0	0	0	0	
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	0	0	0	0	0	0	
6. TOTAL	0	0	0	0	0	0	
D. TOTAL FUEL COMBUSTION	57	34	46	26	219		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	758	0		
B. POINT SOURCES	161	0	11	0	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	39	6	42	13	13	8,538	tons/year
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	0	0	0	0	0	0	
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	39	6	42	13	13	8,538	tons/year
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	34	21	11,662	1,597	1,010	102,136	10^3 V-M/yr.
2. MOTOR VEHICLES-DIESEL	18	33	237	47	248	2,104	10^3 gal./yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	0	0	0	0	0	0	10^3 gal./yr.
2. GASOLINE	0	0	0	0	0	0	10^3 gal./yr.
C. AIRCRAFT	0	0	0	0	0	0	
D. RAILROADS	5	14	15	11	16	430	10^3 gal./yr.
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	244	0		
F. TOTAL TRANSPORTATION	57	68	11,914	1,699	1,274		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	198	0	0	0	0		
VI. GRAND TOTAL							
A. AREA SOURCE	338	108	12,002	2,690	1,480		
B. POINT SOURCE	164	0	11	6	26		
C. TOTAL	502	108	12,013	2,696	1,506		

TABLE 5

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA, CITY OF GRAND FORKS

AIR QUALITY CONTROL REGION 172

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[redacted]	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	4	17	2	1	5	820	10^3 gal/yr.
3. NATURAL GAS	7	0	7	3	27	732	10^6 ft^3/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	2	0	2	1	6	619	10^3 gal/yr.
6. TOTAL	13	17	11	5	38		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	1,206	455	27	14	199	26,568	tons/yr.
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	4	10	0	1	15	482	10^3 gal/yr.
b. DISTILLATE OIL-POINT SOURCE	9	24	0	2	36	1,212	10^3 gal/yr.
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0	0	
5a. NATURAL GAS-AREA SOURCE	9	0	8	5	40	909	10^6 ft^3/yr.
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0	0	
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0	0	
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	0	0	0	0	2	155	10^3 gal/yr.
9. TOTAL	1,228	489	35	22	292		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	1,340	1,230	108	55	811	108,000	tons/yr.
3. DISTILLATE OIL	0	0	0	0	0	0	
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	0	0	0	0	0	0	
6. TOTAL	1,340	1,230	108	55	811		
D. TOTAL FUEL COMBUSTION	2,581	1,736	154	82	1,141		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	646	0		
B. POINT SOURCES	0	0	0	0	0	0	
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	25	5	36	11	11	7,119	tons/yr.
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	0	0	0	0	0	0	
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	25	5	36	11	11	7,119	tons/yr.
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	29	18	9,749	1,343	879	87,975	10^3v-mi/yr.
2. MOTOR VEHICLES-DIESEL	16	28	202	40	211	1,243	10^3 gal/yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	0	0	0	0	0	0	
2. GASOLINE	0	0	0	0	0	0	
C. AIRCRAFT	0	0	0	0	0	0	
D. RAILROADS	2	6	6	5	7	182	10^3 gal./yr.
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	276	0		
F. TOTAL TRANSPORTATION	47	52	9,957	1,614	1,097		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	0	0	0	0	0	0	
VI. GRAND TOTAL							
A. AREA SOURCE	98	84	10,012	2,282	1,203		
B. POINT SOURCE	2,555	1,709	135	71	1,046		
C. TOTAL	2,653	1,793	10,147	2,353	2,249		

TABLE 6

EMISSIONS INVENTORY SUMMARY FOR THE STATE OF NORTH DAKOTA, CITY OF MINOT

AIR QUALITY CONTROL REGION 172

DATA REPRESENTATIVE OF CALENDAR YEAR 1970

	TONS OF POLLUTANT/YEAR					[illegible]	
	Particulate	SO_2	CO	HC	NO_x	Quantity	Units
I. FUEL COMBUSTION							
A. RESIDENTIAL FUEL-AREA SOURCE							
1. (ANTHRACITE) COAL	0	0	0	0	0	0	
2. DISTILLATE OIL	3	14	2	1	4	692	10^3 gal/yr.
3. NATURAL GAS	16	0	17	7	62	1,662	10^6 ft^3/yr.
4. WOOD	0	0	0	0	0	0	
5. LPG	2	0	2	1	6	512	10^3gal/yr.
6. TOTAL	21	14	21	9	72		
B. COMM-INSTL & IND							
1a. (BITUMINOUS) COAL-AREA SOURCE	0	0	0	0	0	0	
b. (BITUMINOUS) COAL-POINT SOURCE	42	106	40	12	24	8,000	tons/yr.
2. COKE-POINT SOURCE	0	0	0	0	0	0	
3a. DISTILLATE OIL-AREA SOURCE	4	11	0	1	16	543	10^3 gal/yr.
b. DISTILLATE OIL-POINT SOURCE	0	0	0	0	0	0	
4a. RESIDUAL OIL-AREA SOURCE	0	0	0	0	0	0	
b. RESIDUAL OIL-POINT SOURCE	0	0	0	0	0	0	
5a. NATURAL GAS-AREA SOURCE	12	0	13	5	49	1,315	10^6 ft^3/yr.
b. NATURAL GAS-POINT SOURCE	0	0	0	0	0	0	
6. PROCESS GAS-POINT SOURCE	0	0	0	0	0	0	
7a. WOOD-AREA SOURCE	0	0	0	0	0	0	
b. WOOD-POINT SOURCE	0	0	0	0	0	0	
8. LPG-AREA SOURCE	0	0	0	0	2	128	10^3 gal/yr.
9. TOTAL	58	117	53	19	91		
C. STEAM-ELECTRIC POWER PLANT							
1. ANTHRACITE COAL	0	0	0	0	0	0	
2. BITUMINOUS COAL	970	460	40	20	304	40,400	tons/yr.
3. DISTILLATE OIL	0	0	0	0	0	0	
4. RESIDUAL OIL	0	0	0	0	0	0	
5. NATURAL GAS	0	0	0	0	0	0	
6. TOTAL	970	460	40	20	304		
D. TOTAL FUEL COMBUSTION	1,049	591	114	47	467		
II. PROCESS LOSSES							
A. AREA SOURCES	0	0	0	535	0		
B. POINT SOURCES	1,798	0	0	0	0		
III. SOLID WASTE DISPOSAL							
A. INCINERATION							
1a. ON SITE-AREA SOURCE	31	4	29	9	9	5,893	tons/yr.
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2. MUNICIPAL ETC.- POINT SOURCE	0	0	0	0	0	0	
B. OPEN BURNING							
1a. ON SITE-AREA SOURCE	0	0	0	0	0	0	
b. ON SITE-POINT SOURCE	0	0	0	0	0	0	
2a. DUMPS - AREA SOURCE	0	0	0	0	0	0	
b. DUMPS - POINT SOURCE	0	0	0	0	0	0	
C. CONICAL BURNERS - POINT SOURCE	0	0	0	0	0	0	
D. TOTAL SOLID WASTE DISPOSAL	31	4	29	9	9	5,893	tons/yr.
IV. TRANSPORTATION-AREA SOURCE							
A 1. MOTOR VEHICLES-GASOLINE	30	15	9,204	1,284	897	88,080	10^3 V-M/yr.
2. MOTOR VEHICLES-DIESEL	16	28	202	40	212	1,344	10^3 gal./yr.
B. OFF-HIGH FUEL USAGE							
1. DIESEL	0	0	0	0	0	0	
2. GASOLINE	0	0	0	0	0	0	
C. AIRCRAFT	0	0	0	0	0	0	
D. RAILROADS	1	4	4	3	4	109	10^3 gal./yr
E. GASOLINE HANDLING EVAP. LOSSES	0	0	0	256	0		
F. TOTAL TRANSPORTATION	47	50	9,410	1,583	1,113		
V. MISCELLANEOUS-AREA SOURCES							
A. AGRICULTURAL BURNING	0	0	0	0	0	0	
B. GRAIN ELEVATORS	0	0	0	0	0	0	
VI. GRAND TOTAL							
A. AREA SOURCE	105	79	9,473	2,142	1,261		
B. POINT SOURCE	2,810	556	80	32	328		
C. TOTAL	2,915	645	9,553	2,174	1,589		

Urban Center	Percentage Combustion	Process
Bismarck/Mandan	11.4	72.0
Fargo/West Fargo	41.2	56.1
Grand Forks	97.3	–
Minot	36.0	61.7

B. SULFUR DIOXIDE

Fuel combustion is responsible for over 80 percent of all the sulfur dioxide emissions in North Dakota with coal combustion accounting for about 70 percent of the total. This generalization holds true for both regions and for three of the four urban centers, the Bismarck/Mandan area being the lone exception. Neither Bismarck nor Mandan have any large coal burning operations within their city limits, and both depend heavily on low sulfur natural gas for process heating and space heating.

C. CARBON MONOXIDE

Gasoline powered off-road and highway vehicles produce about 87 percent of all the carbon monoxide emissions in North Dakota. The only other major source is a petroleum refinery outside Mandan which produces 8.9 percent of the state total.

D. HYDROCARBONS

The principal sources of hydrocarbon emissions in North Dakota are evaporative losses from processes (13 percent) and transportation-related losses (68 percent). The process losses are chiefly due to dry cleaning operations, surface coating processes, and evaporation from petroleum storage tanks. The transportation losses are principally derived from evaporation of gasoline from vehicles and gasoline marketing operations.

E. NITROGEN OXIDES

The two most important sources of nitrogen oxides are coal combustion and gasoline engine operation, which contribute 47 percent and 35 percent, respectively, to the state total. Only the Bismarck/Mandan urban area, where negligible amounts of coal are burned, differs significantly from these values. In this area, 67 percent of the nitrogen oxides are emitted by gasoline engines and 16 percent by diesel motor vehicles.

III. AREA DESCRIPTION

North Dakota is the 17th largest state in the Union. Its 70,665 square miles are divided into three geographic regions. From east to west these are the Red River Valley, the Young Drift Plains and the Great Plains. The Red River Valley Region is noted for its highly fertile land. Separated from the Young Drift Plains by escarpments, its main products are wheat and dairy products. The Young Drift Plains' main industry is also agriculture. These plains are bordered on the east by the Pembina Mountains, on the north by the Turtle Mountains and on the west by an escarpment. The Great Plains are in the Western part of the state. The soil here is not of as high a quality as it is in the rest of the state; hence, it is used for cattle grazing. This area is also rich in mineral deposits, and coal, natural gas, petroleum, sand and gravel are produced here. The main agricultural products of these regions are wheat and flaxseed with lesser amounts of oats and potatoes being produced. The major industries are cattle, meat packing, and dairy products.

The meteorological data of the area show that it is basically a cool dry area with weather patterns which indicate good ambient air circulation. The average low temperature is 0 degrees in January while the average high is 84 in July. For a given year,the average number of degree days (a measure of heating requirements in buildings) is 9300. The average yearly precipitation is 18 inches. Due to the different regions in the state, no single statement can be made about prevailing winds; however, from the air pollution standpoint it is important to note that the average percentage of days with calm winds is 3 percent. When this is compared to Los Angeles' value of 13 percent, North Dakota should have significantly less trouble with photochemical smog formation.

IV. METHODOLOGY

A. DEFINITION OF POINT AND AREA SOURCES

Emissions inventories consider two types of emissions sources, point and area sources. Point sources are generally large establishments which have emissions great enough to warrant individual consideration. The other source classification, area sources, has emissions which are too small to consider individually and are accounted for collectively.

1. Definition of Point Sources

The Federal Register (Volume 36, No. 67, Part II, Appendix C) lists those major pollutant source categories which are to be classified as point sources, independent of size. North Dakota contains the following industrial categories which are included in the Federal listing:

Charcoal Manufacturing
Alfalfa Dehydrating
Feed and Grain Handling and Processing
Meat Smoke Houses
Gray Iron Foundries
Asphalt Roofing
Asphaltic Concrete Batching
Bricks and Related Clay Refractories
Concrete Batching
Paperboard Manufacturing
Rock, Gravel and Sand Quarrying and Processing
Steam Electric Power Plants
Petroleum Bulk Storage Terminals
Petroleum Refining and Production
Natural Gas Refining and Production

In addition to the above industrial classifications, all fuel combustion sources were considered point sources if one or more of the following air pollutant emission criteria were met:

a. Annual Particulate Emissions of 5 tons or Greater.

b. Annual Sulfur Dioxide Emissions of 10 tons or Greater.

c. Annual Nitrogen Oxide Emissions of 25 tons or Greater.

2. Definition of Area Sources

Area sources are defined as those combustion and process sources which in themselves are too small to constitute a point source, but when considered collectively, will significantly contribute to the total emissions of the study area.

The following presents a listing of those categories considered as area sources in North Dakota. However, these categories exclude those individual sources which have emissions large enough to classify them as point sources.

a. Fuel Combustion - Stationary Sources

(1) Residential - Combustion of distillate oil, natural gas, and liquified petroleum gas (LPG) accounts for pollutant emissions from residences. A negligible amount of coal is used in North Dakota for residential purposes.

(2) Commercial and Institutional - Area source emissions in this category result from the combustion of distillate and residual fuel oil, natural gas and LPG. The coal used in North Dakota in this category is virtually all accounted for by point sources.

(3) Industrial - Area source emissions in this category result from the combustion of distillate oil, residual oil and natural gas. Essentially all the industrial coal utilized is accounted for by point sources.

b. Process Losses

(1) Dry cleaning establishments.

(2) Surface coating operations.

(3) Grain Elevators - This category only includes those elevators that did not return questionnaires. For these non-responding sources, emissions were estimated, based on information obtained from returned questionnaires.

c. Solid Waste Disposal

(1) On-site open burning of refuse.

(2) On-site incineration of refuse.

d. Transportation

(1) Motor Vehicles - Both gasoline and diesel powered vehicles are included.

(2) Locomotives.

(3) Aircraft - Only commercial flights are considered.

(4) Tractors - Tractors are the major off-highway consumer of both diesel oil and gasoline.

(5) Evaporative losses from gasoline marketing.

B. POINT SOURCE METHODOLOGY

1. Data Collection

a. Preparation of Mailing List

Using the previously discussed list of point sources, a mailing list of potential point sources in North Dakota was prepared. questionnaire and cover letter, which gave a brief description of the program, were mailed to each of the potential sources. The references used in compiling the mailing list, the cover letter, and sample questionnaires are shown in the Appendix.

As discussed earlier, a fuel combustion source, other than those specified in the Federal listing of major industrial categories, was classified as a point source if its annual emission level for particulate, SO_2, or NO_x was equal to or greater than 5, 10, and 25 tons, respectively.

In compiling this mailing list, however, there were several categories (such as schools, hospitals, hotels, a variety of residential, commercial, institutional, Federal and civic buildings, together with many miscellaneous industries) which, because of a lack of information pertaining to the type and quantity of fuel consumed, could not definitely be classified as point sources. Working criteria for the completion of the point source mailing list were then established and are presented below:

Manufacturing & Commercial Establishments	- more than 25 employees
Schools and Colleges	- more than 100 students
Hospitals	- more than 50 beds
Hotels and Motels	- more than 100 rooms.

These criteria were modified as required in the light of knowledge of either State or GCA personnel as well as data available from the individual sources.

b. Questionnaire Follow-up

The follow-up to the questionnaire mailing phase of the program consisted of two parts: (1) the determination of the significant potential point sources which had not responded or which had responded with insufficient data, and (2) the recontacting of these sources. Recontacting was by telephone, personal contact or by another letter. Emphasis was placed on those sources which appeared to be large emitters of pollutants such as power plants, but other categories were contacted as well.

In many cases, returned questionnaires indicated that the source emitted less than 0.5 tons of uncontrolled pollutant. Because input to the computer program used for the emissions inventory compilation requires that emissions be rounded to the nearest ton, such emissions were considered zero.

Table 7 presents a summary of the number of potential point sources to which questionnaires were sent, the final number of responses and the percentage response for the various categories. Telephone conversations with non-respondents which resulted in sufficient data for

TABLE 7

SUMMARY OF RESPONSE TO QUESTIONNAIRE MAILING

Category	No. of Potential Sources	No. of Responses	Percentage Response
Charcoal	1	1	100.0
Detergent and Soap	4	4	100.0
Fertilizer	1	1	100.0
Alfalfa Dehydration	3	2	66.7
Grain Elevators	666	373	56.0
Meat Smokehouses	11	8	72.7
Starch Manufacturing	1	1	100.0
Gray Iron Foundries	4	3	75.0
Asphaltic Concrete Batching	32	24	75.0
Asphalt Roofing	26	16	61.5
Bricks & Related Clay Refractories	2	1	50.0
Coal Cleaning	2	2	100.0
Concrete Batching	64	30	46.9
Rock, Sand & Gravel Quarrying and Processing	17	10	58.8
Natural Gas Refineries	3	3	100.0
Petroleum Refineries	2	2	100.0
Oil and Gas Wells	96	71	74.0
Paperboard Manufacturing	1	1	100.0
Sawmills and Planing Mills	5	4	80.0
Electric Power Plants	12	12	100.0
Schools & Colleges	31	31	100.0
Hospitals	33	32	97.0
Hotels & Motels	20	13	65.0
Dairy Products	9	5	55.6
Meat Packers	4	3	75.0
Other Food Industries	18	12	66.7
Printing and Publishing	4	4	100.0
Metal Products	16	7	43.8
Coal Mining Companies	4	4	100.0
Pipe Line Companies and Storage	8	8	100.0

TOTALS: No. of Potential Sources = 1,100
Number of Responses = 688
Percentage of Response = 62.5

evaluation are considered as responses. In general, the percentage response reflects the relative importance of the source category. However, one category with a poor percentage response, grain elevators, is a large pollution source and emissions from non-responding sources in this category were estimated using average emission levels obtained from the respondents. As previously noted, these estimated emissions were then included as an area source.

The overall response of 62.5 percent is considered quite good in view of the voluntary cooperation required of the contacted sources. The percentage of total emissions accounted for by this survey is believed to be much greater than the percentage response, because virtually all of the known major emission sources were contacted.

2. Data Analysis

Analysis of the data from the completed questionnaires consisted of two essential phases: a. the choice and use of a coordinate system for defining the locations of point sources, and b. the transforming of raw data from the questionnaires into the form required for input to the computer program used by the Office of Air Programs (OAP) for the final emissions inventory calculations.

a. Coordinate System

The Universal Transverse Mercator (UTM) coordinate system was chosen for North Dakota because: (a) the system is widely used in meteorological modeling, (b) maps with the UTM grids denoted are readily available from the U.S. Geological Survey (USGS), and (c) the UTM system does not suffer from grid irregularities to the same extent as do most other systems, notably, the township/section system used in North Dakota. In general, the locations of individual point sources were determined to within one kilometer in either (flat projection) dimension.

b. Computer Input Forms

The details of the data manipulation required for data transformation will not be discussed here. Instead, some critical assumptions and statements of policy regarding data treatment will be reviewed in the following material.

(1) Stack Parameters - Information concerning stack heights, diameters, and flow conditions are given only for sources emitting 50 tons or more per year of any pollutant. In most cases where such data are given, they are based on estimates using OAP recommended procedures.

(2) Process Weights - In most cases, the respondents gave this information, but grain elevators generally did not. To obtain process weights for these sources, a grain-handling time of 1000 hours per year was assumed for country elevators, and 2000 hours per year for terminal elevators after talks with some operators. In some cases, a lack of sufficient data required that the maximum process weight be set equal to the normal process weight.

(3) Fuel Characteristics - In almost all cases, these were given on the returned questionnaires. In those few cases where such data were not given, either State Laboratory Commission data[16] or data from other similar point sources were used.

(4) Pollution Control Efficiency - Major point sources gave control efficiencies almost without exception, but many smaller sources did not have such data. The values given by McGraw and Duprey [20] were normally used where the data were missing. However, because of the usual operating procedures at grain elevators, the dust houses frequently used were assumed to have a zero percent particulate removal efficiency.

(5) Emissions - Some respondents included estimates of actual emissions on their returned questionnaires. These data were used if they showed reasonable agreement with estimates obtained by the use of emission factors. Otherwise, the estimated values based on emission factors were used.

(6) Allowable Emission - Legally permissible emissions of sulfur dioxide and particulates by both North Dakota law[18] and the Federal model standards[19] were hand calculated for all regulated point sources in the state. The Federal model sulfur dioxide emission was calculated for combustion sources by assuming 80 percent removal.

C. AREA SOURCES

1. Area Source References

References used to compile data for the consumption and apportionment of area source fuel, solid waste and evaporative losses in North Dakota are summarized in Appendix C. These references include both local and state data together with data compiled by private companies and by Federal agencies such as the Census Bureau and the Bureau of Mines.

2. Data Analysis

The following section discusses the methodology utilized in estimating and apportioning fuel, solid waste, and process area source emissions.

Because a variety of area source categories utilize a number of different types of fuels, Table 8, which summarizes these fuel consuming area source categories and the types of fuels utilized, has been prepared. The ensuing discussion of stationary fuel combustion and transportation area sources is based upon this table.

a. Stationary Fuel Combustion

(1) Coal - The Bureau of Mines[25] has published data for coal consumption in North and South Dakota combined, but no values were available for the states individually. However, consumption totals obtained from the point source questionnaires of these states exceed the combined total published by the Bureau of Mines. Therefore, it was concluded that all coal consumption in North Dakota is accounted for by point sources and that area source coal consumption is essentially zero. This was confirmed by communications with various state officials familiar with coal usage in North Dakota.

(2) Residual Oil - Returned questionnaires indicate that residual oil consumed by point sources exceeds the Bureau of Mines consumption total[26] for North Dakota. Hence, it was concluded that residual oil consumption in North Dakota is accounted for by point sources and

TABLE 8

FUELS CONSUMED BY AREA SOURCES IN NORTH DAKOTA

Combustion Category	Coal	Residual Oil	Distillate Oil* K	Distillate Oil* D	Distillate Oil* 2-4	Gasoline	Natural Gas	LP-Gas
Stationary Sources								
1. Residential	0	0	X	NA	X	NA	X	X
2. Commercial-Institutional	0	0	X	NA	X	NA	X	X
3. Industrial	0	0	0	NA	X	NA	X	0
Transportation								
1. Railroads	NA	X	NA	X	NA	NA	NA	NA
2. Motor Vehicles	NA	NA	NA	X	NA	X	NA	0
3. Tractors	NA	NA	NA	X	NA	X	NA	0
4. Aircraft	NA	NA	X	NA	NA	X	NA	NA

Legend:
X - fuel is used
0 - fuel is not used or use is negligible
NA - not applicable

Notes:
* K - kerosene
D - diesel fuel
2-4 - No. 2, 3, & 4 heating oil

that area source residual oil consumption is essentially zero. This is confirmed by communications with various state officials familiar with residual oil usage in North Dakota.

(3) Distillate Oil - Total distillate oil utilized in North Dakota in 1969 was obtained from Bulletin No. 158 of the North Dakota State Laboratories Commission[5]. This total included kerosene and jet fuel as well as distillate oil. Distillate oil consumed by railroads in North Dakota is not included in this figure. After subtracting the kerosene and jet fuel consumed in the state in 1969, the remaining distillate oil was apportioned to the following use categories, utilizing Bureau of Mines fuel oil consumption data for North Dakota[26]:

(a) Commercial and Institutional Distillate Oil - The Bureau of Mines fuel oil consumption data did not distinguish between residential and commercial/institutional usage. Residential heating requirements were estimated, based on the 1970 Bureau of Census data for housing units, the number of degree days per year, and the average annual heating requirements per home.

The quantity of residential heat supplied by natural gas was then subtracted to give residential fuel oil consumption. The resulting value was subtracted from the total residential, commercial and institutional fuel oil consumption to obtain the distillate fuel oil consumed by commercial and institutional establishments in the state.

This total was apportioned to the counties (as well as the four principal metropolitan areas) by the number of wholesale plus retail establishments, which was obtained from the North Dakota Business and Industrial Development Department[6]. These figures were then adjusted to reflect those establishments NOT being serviced by natural gas.

Emissions were calculated by means of the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors, 1971[20]. An average sulfur content of 0.279 percent was assumed, based on data from the State Laboratories Department[5].

(b) Residential Fuel Oil - The state consumption of kerosene was included in this total. The state usage was apportioned to the counties and the four major urban areas by population[13]. The county and city populations were adjusted to reflect the population NOT being serviced by natural gas.

Emissions were calculated utilizing the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors, 1971[20]. An average fuel sulfur content of 0.279 percent was assumed, based on data from the State Laboratories Commission[5].

(c) Industrial Distillate - State totals were apportioned to the counties and the four major cities by the number of manufacturing establishments after subtracting the industrial point source consumption. Again, these apportioning figures were adjusted to reflect those industries NOT being serviced by natural gas.

Emissions were calculated using the emission factors of McGraw and Duprey[20].

(d) On-Highway Diesel Fuel - Because this category is classified as a transportation source, the methodology discussion is presented in Section C.2.b.

(e) Off-Highway Diesel Fuel - Because this category is also classified as a transportation source, the methodology discussion is presented in Section C.2.b.

(4) Natural Gas - Natural gas is utilized in 21 counties in North Dakota including Burleigh/Morton, Cass, Grand Forks, and Ward counties, which contain the respective metropolitan areas of Bismarck/Mandan, Fargo/West Fargo, Grand Forks, and Minot. Natural gas consumption data for 1970 were available by use category (residential, commercial/institutional, and industrial) for these areas as well as the counties. The data were obtained from the three companies (Montana Dakota Utilities Co., Great Plains Natural Gas, and Northern States Power Co.) supplying gas to North Dakota[1,2,3].

Emissions were calculated through use of the emission factors presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971[20].

(5) Liquified Petroleum Gas (LPG) - State consumption totals were obtained from the Bureau of Mines[27] and apportioned by population data[13], adjusted to reflect those NOT serviced by natural gas. Emissions were calculated utilizing the emission factors for domestic and commercial propane as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971[20]. The emission factor for nitrogen oxide was assumed to be 23 pounds per thousand gallons, based on the assumption that 80 percent of the LPG was utilized by domestic sources and 20 percent by commercial sources[27].

b. Transportation

(1) Gasoline-Powered Motor Vehicles - Urban and rural vehicle mile data for 1969 were available by county and for the four major metropolitan areas[9]. It was assumed that 98 percent of the vehicle miles were attributed to gasoline powered motor vehicles[19] and the emission factors presented by McGraw and Duprey[20] were utilized to obtain county and city emissions from on-highway gasoline consumption.

(2) Off-Highway Gasoline (Farm Tractors) - Total off-highway gasoline sold in 1970 (that quantity of gasoline which is tax exempt) was available from the state[8] and was assumed to be essentially all consumed by tractors. Therefore, this fuel was apportioned to the counties by crop-acres[6]. Emissions were calculated based upon the emission factors for gasoline powered motor vehicles traveling at 25mph as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors, 1971[20]. However, the values presented in this text were adjusted by a factor of 12.5 v-m/gal to obtain units of lbs pollutant/1000 gallons of gasoline.

(3) Diesel Powered Motor Vehicles - As stated earlier, on-highway diesel consumption was derived by utilizing Bureau of Mines

data[26] to apportion the state consumption of distillate fuel oil in 1970 by use category. On-highway diesel consumption using this technique agreed well with state totals obtained directly from the State Tax Commission[8]. The value obtained from the state was felt to be more reliable and was utilized in this study.

On-highway diesel fuel was apportioned to the counties and the four metropolitan areas under investigation by motor vehicle miles obtained from the North Dakota Highway Department[9]. Emissions were calculated by means of the emission factors for heavy duty trucks and buses with engines built prior to 1970 as presented in McGraw and Duprey's Compilation of Air Pollutant Emission Factors - 1971[20].

(4) Off-Highway Diesel Fuel (Farm Tractors) - As mentioned earlier, off-highway diesel fuel consumption was derived by utilizing Bureau of Mines statistics[26] to apportion the state consumption of distillate fuel oil in 1970 by use category. The resulting off-highway diesel fuel was assumed to be essentially all utilized by farm tractors and was apportioned to the counties by crop-acres[6]. Emission factors similar to those used for on-highway diesel fuel were utilized here.

(5) Aircraft (Commercial Only) - Emissions from aircraft at the seven major municipal airports were based on the number of landing and takeoff cycles (LTO) and aircraft types employed at each location, as described by McGraw and Duprey[20]. Airline schedules (effective dates April 25, 1971)[19] for the three commercial airlines operating in North Dakota (Frontier, North Central, and Northwest Orient) were utilized to determine the annual LTO's per airport and the type of aircraft employed. The pertinent data for aircraft operations are listed in Appendix D.

(6) Railroads - The quantity of fuel oil utilized by railroads in North Dakota was obtained from Bureau of Mines data[26] and adjusted to reflect the difference between annual fuel oil sales as reported by the Bureau of Mines[26] and by state statistics[8]. This value was then apportioned to counties by track-miles as determined from a recently published detailed map of the state.

Fuel oil consumption by railroads in the four major metropolitan areas was obtained directly from the railroads.[28] The chief concern in this category was fuel oil consumption utilized for switching operations as this is the major source of emissions from railroads within the city limits.

Emissions were calculated using the emission factors for railroads as presented in McGraw and Duprey's Compilation of Air Pollutant Emissions Factors - 1971.[20]

(7) Evaporative Losses from Gasoline Marketing - Total gasoline sold both for highway and off-highway use in 1970 was available from the State Tax Commissioner's Office. The quantity of highway gasoline marketed was apportioned to the counties and cities under study by total vehicle miles as obtained from the Highway Department. Off-highway gasoline marketed was apportioned to the counties by farm acres. The emissions were calculated based upon 21 pounds of hydrocarbons for each 1000 gallons of gasoline sold.

c. Solid Waste Disposal

The state of North Dakota does not have a recent survey of solid waste disposal available at this time. However, an earlier report[11] and discussions with State Health Department personnel[12] indicated that at least 75 percent of the state population is served by sanitary landfills. The larger towns with refuse collection facilities generally have landfill operations, while considerable on-site open burning takes place in rural areas. There are no municipal incinerators in the state and no other incinerators were found which constituted point sources. Because of the lack of better data, it was necessary to treat solid waste disposal as an area source.

The OAP-suggested value of 7 pounds per person per day of municipal refuse generation from residential, commercial, and institutional sources was assumed. It was further assumed that 75 percent of this refuse (5.25 lb/person per day) was landfilled and that the remaining 25 percent (1.75 lb/person per day) was distributed such that two thirds was open-burned and one-third was incinerated.

All of the four metropolitan areas of interest in the survey, Bismarck/Mandan, Fargo/West Fargo, Grand Forks, and Minot, are served by municipal collection facilities and landfills. Further, they all have ordinances against open-burning. Therefore, it was assumed that all residential waste (5.5 pounds/person per day, reference 20) was landfilled. The remaining 1.5 pounds/person per day was assumed to be split equally between landfills and commercial-institutional incinerators.

Emissions were calculated by means of the emission factors of McGraw and Duprey[20] and assuming that multiple chamber incinerators were used.

d. Process Losses

(1) Grain Elevators

As mentioned earlier, some grain elevators did not return questionnaires. These non-respondents were treated as area sources in their respective counties. Average emissions for both the country and terminal elevators were determined from those questionnaires that were returned. The appropriate emission was then assigned to the non-responding elevators on the basis of the elevator type, i.e. country or terminal.

(2) Dry Cleaning

McGraw and Duprey[20] have estimated that hydrocarbon emissions from dry cleaning operations in cold climates, such as that of North Dakota, average 2.7 pounds per person per day. This value was used for the determination of emissions from this source for the counties and four major urban areas of North Dakota.

(3) Surface Coating Operations

This category includes chiefly the application of paints and varnishes for protective and/or decorative purposes. No state surface coating consumption data were available for North Dakota, but a national total for paint and varnish was obtained from the U.S. Paint and Varnish Association.[24] From this total and the national population, it was

determined that per capita consumption of paint and varnish is 0.0243 tons/person per year. This value was used with North Dakota population data[13] to determine the paint and varnish used in the pertinent geographical areas in the state. Information from the Paint and Varnish Association[24] indicated that the solvent content of these coatings averaged about 62.5 percent. In determining the hydrocarbon emissions from solvent evaporation, it was assumed that all of the solvent was hydrocarbon and that it all evaporated.

V. COMPUTER PRINTOUT

The detailed results of the emissions inventory are presented in the computer printout which is enclosed in a separate binder.

The printout is arranged by Air Quality Control Region, and for each region, there is a point source printout and an area source printout. The point source printout presents detailed data and also summaries of annual emissions by source category for each political jurisdiction (county) within the region; these summaries are tabbed, "#8". Similarly, the area source printout presents detailed data and also summaries of annual emissions by source category for each political jurisdiction (county) within the region; these summaries are tabbed, "#18".

Detailed notes on the data provided in the printout are now presented. They are arranged to follow the sequence of the printout sheets and should be read in conjunction with general explanations given in the Methodology section of this report. Numbered tabs are attached to the printout pages to indicate the first page of each listing.

A. POINT SOURCE PRINTOUT

1. Listing #1

The table presented correlates the emission factor set numbers shown in Listing #3 to the emission factors used in the computer-calculated emissions.

2. Listing #2

a. Standard Industrial Classifications (SIC) and Process Codes were assigned to each source as shown in Table 9. If more than one source had the same classification and process code, consecutive Site numbers were assigned to such sources.

b. The counties corresponding to the Political Jurisdiction numbers listed are shown in Table 10.

c. Each source was classified by Type as either Process, Boiler or Solid Waste. With the exception of flares and gas engines

TABLE 9

STANDARD INDUSTRIAL CLASSIFICATION (SIC) NUMBERS AND ASSOCIATED PROCESS CODES

The source type identification code scheme used in this table is composed of the following sets of numbers:

A four-digit Standard Industrial Classification (SIC) code. XXXX, which identifies the nature of the industry.

A two-digit process code, XX, which provides the process classification.

A zero in the second location of the process code (XO) indicates a fuel combustion source. In this case, the first digit (X) identifies the fuel burner type (as defined below).

The fuel burner types defined by the process codes 00, 10, 20, ...90 are defined as follows:

00. All types not listed
10. Pulverized, General
20. Pulverized, Dry Bottom
30. Wet Bottom without Flyash Reinjection - Pulverized
40. Pulverized, Wet Bottom with Flyash Reinjection
50. Cyclone
60. Spreader Stoker without Flyash Reinjection
70. Spreader Stoker with Flyash Reinjection
80. All other Stokers
90. Hand Fired

****

SOURCE TYPES FOUND IN NORTH DAKOTA

2029 DAIRY PRODUCTS

XO. Combustion
01. General

2041 FLOUR AND OTHER GRAIN MILL PRODUCTS

XO. Combustion
01. General
02. Wheat
03. Barley

TABLE 9 (Continued)

2042 PREPARED FEEDS FOR ANIMALS AND FOWL

XO. Combustion
01. General
02. Alfalfa

2099 FOOD PREPARATIONS, NOT ELSEWHERE CLASSIFIED

XO. Combustion
01. General

2911 PETROLEUM REFINING

XO. Combustion
01. Fluid Catalytic Units
02. Moving Bed Catalytic Units
03. Sulfur Recovery
04. Acid Refining of Lube oils
05. Microfines Unit
06. Calciner Unit
07. Fluid Cokes
08. Process Emissions Source

2951 ASPHALT BATCHING

XO. Combustion
01. Batching
02. Quarrying
03. Rock Drying
04. Sheet Rock Cutting and Trimming

2952 ASPHALT FELTS AND COATINGS

XO. Combustion
01. General

2999 PRODUCTS OF PETROLEUM, NOT ELSEWHERE CLASSIFIED

XO. Combustion
01. General

3273 READY-MIXED CONCRETE

XO. Combustion
01. General

3295 MINERALS AND EARTHS, GROUND OR OTHERWISE TREATED

XO. Combustion
01. Crushing
02. Conveying, Screening, and Shaking
03. Storage Piles

TABLE 9 (Continued)

3321 GRAY IRON FOUNDRIES

XO. Combustion
01. Cupola
02. Electric Induction
03. Reverbatory Furnace

4911 ELECTRIC COMPANIES AND SYSTEMS

XO. Combustion

4931 ELECTRIC AND OTHER SERVICES COMBINED (Electric service less than 95% of total)

XO. Combustion

4953 REFUSE SYSTEMS

XO. Combustion (fuel)
01. Municipal Incinerator
02. Open Burning
03. On-Site Multichamber Incinerator
04. On-Site Single Chamber Incinerator
05. Flue-fed Incinerator
06. Other

8061 HOSPITALS

XO. Combustion

8221 COLLEGES, UNIVERSITIES AND PROFESSIONAL SCHOOLS

XO. Combustion

8999 SERVICES, NOT ELSEWHERE CLASSIFIED

XO. Combustion

9100 FEDERAL GOVERNMENT

XO. Combustion

TABLE 10

POLITICAL JURISDICTIONS INCLUDED WITHIN AIR QUALITY CONTROL REGIONS IN NORTH DAKOTA

Metropolitan Fargo - Moorhead Interstate Air Quality Control Region - 130

In the State of Minnesota:

1. Clay County

In the State of North Dakota:

2. Cass County

North Dakota Intrastate Air Quality Control Region (remaining area) - 172

1. Adams
2. Barnes
3. Benson
4. Billings
5. Bottineau
6. Bowman
7. Burke
8. Burleigh
9. Cavalier
10. Dickey
11. Divide
12. Dunn
13. Eddy
14. Emmons
15. Foster
16. Golden Valley
17. Grand Forks
18. Grant
19. Griggs
20. Hettinger
21. Kidder
22. Lamoure
23. Logan
24. McHenry
25. McIntosh
26. McKenzie
27. McLean
28. Mercer
29. Morton
30. Mountrail
31. Nelson
32. Oliver
33. Pembina
34. Pierce
35. Ramsey
36. Ransom
37. Renville
38. Richland
39. Rolette
40. Sargent
41. Sheridan
42. Sioux
43. Slope
44. Stark
45. Steele
46. Stutsman
47. Towner
48. Traill
49. Walsh
50. Ward
51. Wells
52. Williams

associated with petroleum and natural gas production, all fuel combustion sources were considered boilers. The flares and engines were considered processes (Code 08) and were assigned to the Process type classification.

3. Listing #3

a. The Shifts/Day value is the ratio of the reported total operating hours from listing #2 to 2920 (the total hours in one-year of one-shift per day operation).

b. The Use Factor is the ratio of the maximum process weight rate (lb./hr.) to the normal (or average) process weight rate (lb./hr.) for process sources. For combustion sources, the Use Factor is the ratio of the boiler capacity (10^6 BTU/hr.) to the average heat input (10^6 BTU/hr.). The latter value is the product of the total fuel consumed and the fuel heating value divided by the total operating time.

4. Listing #4

This listing is self-explanatory and no further comments will be included here.

5. Listing #5

This listing gives the totals of fuels consumed during the year within the region. Note, for Region No. 172, three tables are presented for each fuel. Regional totals are obtained by adding the values from all of these tables.

6. Listing #6

a. Computer Calculated emissions were made only for fuel combustion sources, using the fuel totals and emission factor set numbers indicated. Solid waste and process sources were hand calculated. These hand calculations were based on annual solid waste and process totals together with emission factors from McGraw and Duprey (Reference 17, Appendix A).

b. The Uncontrolled emission value is the sum of the computer calculated and hand calculated values.

c. The Controlled emission value is the uncontrolled emission value minus the product of the Control Efficiency and the Controlled value.

d. The Device Identification numbers correspond to the control devices listed in Table 11 of this report.

e. The Allowable particulate and SO_2 emission values are those permitted by North Dakota Regulation No. 82 (Reference 18, Appendix A).

7. Listing #7

The notes for Listing #6 are applicable to this listing, but neither control devices nor allowable emissions are considered.

8. Listing #8

This listing gives total emissions in tons per year for each political jurisdiction (county) within the region. The totals are presented by source category and fuel totals are included for combustion sources. Refuse totals are presented for each of the solid waste categories. The industrial-commercial-institutional fuel combustion source of political jurisdiction 29 (Morton County), Region 172, in the "Other" category is a petroleum refining operation which consumes large amounts of high-sulfur content process oil and gas.

9. Listing #9

a. Allowable Emissions - The allowable emissions of particulates and SO_2 based on the federal model standards (Reference 19, Appendix A) are presented for all regulated point sources in North Dakota.

b. The Zone numbers specify whether the point source is located in zone 13 or zone 14 of the Universal Transverse Mercator (UTM) coordinate system.

TABLE 11

POLLUTION REDUCTION DEVICES OR METHODS

001	Wet Scrubber - High Efficiency
002	Wet Scrubber - Medium Efficiency
003	Wet Scrubber - Low Efficiency
004	Gravity Collector - High Efficiency
005	Gravity Collector - Medium Efficiency
006	Gravity Collector - Low Efficiency
007	Centrifugal Collector - High Efficiency
008	Centrifugal Collector - Medium Efficiency
009	Centrifugal Collector - Low Efficiency
010	Electrostatic Precipitator - High Efficiency
011	Electrostatic Precipitator - Medium Efficiency
012	Electrostatic Precipitator - Low Efficiency
013	Gas Scrubber
014	Mist Eliminator - High Velocity
015	Mist Eliminator - Low Velocity
016	Fabric Filter - High Temperature
017	Fabric Filter - Medium Temperature
018	Fabric Filter - Low Temperature
019	Catalytic Afterburner
020	Catalytic Afterburner with Heat Exchanger
021	Direct Flame Afterburner
022	Direct Flame Afterburner with Heat Exchanger
027	Eliminate Coal Combustion
028	Eliminate Coal and Residual Fuel Oil Combustion
029	Change all Fuel Use to Natural Gas
030	No Fuel Use Over a Maximum Sulfur Content (Specified by the User in the Regional Data Base)
031	Same as Device 030 but with a Different Allowable Sulfur Content
039	Catalytic Oxidation - Flue Gas Desulfurization
041	Dry Limestone Injection
042	Wet Limestone Injection
043	Sulfuric Acid Plant - Contact Process
044	Sulfuric Acid Plant - Double Contact Process
045	Sulfur Plant

c. Additional information includes comments helpful in clarifying the location of each of the point sources.

B. AREA SOURCE PRINTOUT

1. Listings #10, #11, #12, #13, #14

Each listing presents emissions of one pollutant in tons per year by political jurisdiction and consists of four tables. Emissions entitled, "Apportioned Emissions", Table 1, and "Calculated Emissions", Table 2, were computer calculated and based on emission factors presented in Table 12 of this report. Note that in Table 2 of the printout, the two columns marked "Other" refer to (from left to right):

a. Farm tractors utilizing diesel fuel
b. Farm tractors utilizing gasoline.

Table 3 of the printout, entitled, "Additional Emissions", was hand calculated. The basis for these hand calculations has been discussed in the Methodology Section (IV) of this report. Note that the explanation of the column numbers of Table 3 of the printout are presented in Table 13 of this report.

In Table 4 of the printout, the total emissions of the preceding 3 tables are given. "Calculated 1" refers to Table 1, "Calculated 2" refers to Table 2, and "Additional" refers to Table 3.

2. Listing #15

Printout Table 5 shows emission and fuel consumption totals for the regions. The source categories and appropriate units for the fuel totals corresponding to rows 1 through 22 are listed in Table 12. All emissions are expressed in tons per year.

3. Listing #16

Tables 6-1 and 6-2 of the printout show the factors utilized to apportion each of the 22 fuel totals (see Listing #15) to the political jurisdictions in the regions. Note that the column headings 1-11 in

TABLE 12

AREA SOURCE EMISSION FACTORS

NO.	AREA SOURCE CATEGORY	FUEL UNITS	EMISSION FACTORS (lbs./unit of fuel) PARTIC-ULATE*	SO_2**	CO	HYDRO-CARBONS	NO_x
1	Residential Coal	Tons/year	2(A)	38(S)	50	12	5
2	Residential Oil	10^3 gallons/year	10	144(S)	5	3	12
3	Residential Natural Gas	10^6 cu.ft./year	19	0.6	20	8	75
4	Commercial & Institutional Coal	Tons/year	5(A)	38(S)	50	12	5
5	Commercial & Institutional Residual Oil	10^3 gallons/year	23	159(S)	0.2	3	60
6	Commercial & Institutional Distillate Oil	10^3 gallons/year	15	144(S)	0.2	3	60
7	Commercial & Institutional Natural Gas	10^6 cu.ft./year	19	0.6	20	8	75
8	Industrial Coal	Tons/year	13(A)	38(S)	2	1	15
9	Industrial Residual Oil	10^3 gallons/year	23	159(S)	0.2	3	60
10	Industrial Distillate Oil	10^3 gallons/year	15	144(S)	0.2	3	60
11	Industrial Natural Gas	10^6 cu.ft./year	18	0.6	0.4	40	175
12	Wood	Tons of wood/year	27	1.5	2	2	10
13	Open Burning	Tons of refuse/yr.	16	1	85	30	6
14	Incineration	Tons of refuse/yr.	7	1.5	10	3	3
15	Solvent Evaporation of Paints and Varnishes	Tons of solvent/yr	0	0	0	2000	0
16	Diesel Vessels	10^3 gallons/year	25	144(S)	65	50	73
17	Railroads	10^3 gallons/year	25	65	70	50	75
18	Diesel Motor Vehicles	10^3 gallons/year	25	45	325	65	340
19	Diesel Tractors	10^3 gallons/year	25	45	325	65	340
20	Urban Gasoline Motor Vehicles	10^3 vehicle miles per year	0.66	0.4	264	35.2	18.7
21	Rural Gasoline Motor Vehicles	10^3 vehicle miles per year	0.66	0.4	154	23.1	22
22	Gasoline Tractors	10^3 gallons/year	8.25	5.0	3300	440	233.75

* Particulate emissions from coal combustion obtained by multiplying appropriate factor by percent of ash in coal.

** SO_2 emissions from coal, distillate oil and residual oil combustion obtained by multiplying appropriate factor by percent sulfur in fuel. For distillate oil, the percent sulfur was assumed to equal 0.279%

Table 6-1 correspond to numbers 1-11 in Table 12 of this report and that column headings 1-11 in Table 6-2 correspond to numbers 12-22 of Table 12. Units for the apportioning factors are given in Table 14. A more detailed discussion of the apportioning factors is presented in the Methodology section.

4. Listing #17

Tables 6-3 and 6-4 present the apportioned fuel totals in each political jurisdiction for each of the 22 source categories presented in Listing #15. Again, column headings 1-11 in Table 6-3 correspond to numbers 1-11 of Table 12. Column headings 1-11 in Table 6-4 correspond to numbers 12-22 of Table 12.

5. Listing #18

This listing presents total area source emissions in tons per year for each political jurisdiction within the regions. The totals are presented by source category. As mentioned earlier, the two "Others" in column 1 refer to (from top to bottom),

a. Farm tractors utilizing diesel fuel
b. Farm tractors utilizing gasoline.

The identification of "Additional Pollutant" numbers 1-15 is found in Table 13 of this report.

The fuel total units are the same as those given in Table 12 of this report.

TABLE 13

ADDITIONAL EMISSIONS

No.	Category		Units	Emission Factors (lbs./unit) Particulate	SO_2	CO	Hydrocarbons	NO_x
1	Gasoline Marketing		10^3 gal/yr.	0	0	0	21	0
2	Dry Cleaning		Population	0	0	0	2.7	0
3	Liquified Petroleum Gas (LPG)		10^3 gal/yr.	6.1	0.048	6.4	2.5	23
4	Aircraft	Turbofan-med. range	engine-LTO/yr*	7	2	16	50	7
		Turboprop	engine-LTO/yr*	6	1	2	3	5
5	Grain Elevators	Country	Grain Elevators	132,000	0	0	0	0
		Terminal	Grain Elevators	611,400	0	0	0	0
6-15	Not applicable		--	--	--	--	--	--

*engine-LTO cycle = engine landing-take-off cycle.

TABLE 14. APPORTIONING FACTOR UNITS

SOURCE NO.	APPORTIONING FACTOR UNITS
1	--
2	Number of people
3	10^6 cubic feet per year
4	--
5	--
6	Number of commercial establishments
7	10^6 cubic feet per year
8	--
9	--
10	Number of manufacturers
11	10^6 cubic feet per year
12	--
13	Tons of refuse per year
14	Tons of refuse per year
15	Number of manufacturers
16	--
17	10^3 track miles
18	10^3 diesel vehicle miles per year
19	10^3 crop acres
20	10^4 vehicle miles per year
21	10^4 vehicle miles per year
22	10^3 crop acres

APPENDIX A

LIST OF POINT SOURCE REFERENCES

1. "1971-1972 Directory of North Dakota Manufacturers", Business and Industrial Development Department, State of North Dakota.

2. "North Dakota Growth Indicators -- 1970-71", Business and Industrial Development Department, State of North Dakota.

3. "1970 Directory of Licensed and Bonded Country Elevators in North Dakota", Farmers Grain Dealers Association of North Dakota, Fargo, North Dakota.

4. Appendix F, Parts 1 and 2 of "National Emission Standards Study", A Report to the Congress of the United States by the Secretary, Department of Health, Education, and Welfare, March, 1970.

5. "List of Qualified Contractors", North Dakota State Highway Department, State of North Dakota, 1 July 1970 (Updated to 26 March 1971).

6. North Dakota Telephone Directories for 1970, Northwestern Bell Telephone Company.

7. Minerals Yearbook, 1968, Volume III, Area Reports: Domestic, Bureau of Mines, United States Department of the Interior.

8. "Production Statistics and Engineering Data - Oil in North Dakota", North Dakota Geological Survey, March 1971 (Data for 1st half of 1970).

9. "Steam Electric Plant Factors -- 1968", National Coal Association, Washington, D. C.

10. "Steam Electric Plant Construction Cost and Annual Production Expenses," 21st Annual Supplement -- 1968, United States Federal Power Commission, Published 1970.

11. "Final Fall Enrollment Report -- 1970-71", Board of Higher Education, State Department of Public Instruction, State of North Dakota.

12. "North Dakota Educational Directory -- 1970...1971", Department of Public Instruction, State of North Dakota.

13. "List of North Dakota Hospitals", Division of Health Facilities, Department of Health, State of North Dakota, January 1971.

14. "List of North Dakota Motels and Hotel Facilities", personal communication from Bismarck Chamber of Commerce, Bismarck, North Dakota, April 1971.

15. Personal contacts with employees of the North Dakota State Department of Health. (In particular, the advice of Messrs. Dana Mount, Gene Christianson, Kenneth Kary, Everett Lobb, and Darwin Schultz was useful.)

16. "Petroleum Products and Anti-Freeze 1969 Report," Bulletin No. 158, State Laboratories Department, North Dakota State Laboratories Commission, May 1970.

17. "Air Pollutant Emission Factors," (Preliminary Document), by M. J. McGraw and R. I. Duprey, Office of Air Programs, Environmental Protection Agency, April 1971.

18. "North Dakota Air Pollution Control Regulations," Regulation No. 82, North Dakota State Department of Health, effective date: July 1, 1970.

19. "National Ambient Air Quality Standards," Environmental Protection Agency, Federal Register 36, No. 67, pp. 6680-6701, April 7, 1971.

APPENDIX B

COVER LETTER AND SAMPLE QUESTIONNAIRES

NORTH DAKOTA
STATE DEPARTMENT OF HEALTH
BISMARCK 58501
ENVIRONMENTAL HEALTH AND ENGINEERING SERVICES
W. VAN HEUVELEN, M.S., P.E., CHIEF

HES R. AMOS, M.D.
ATE HEALTH OFFICER

DIVISION OF:
WATER SUPPLY & POLLUTION CONTROL
ENVIRONMENTAL SANITATION & FOOD PROTECTION
ENVIRONMENTAL ENGINEERING

April 26, 1971

Dear Sir:

The Air Pollution Control Program of the North Dakota State Department of Health requests your cooperation in providing the information asked for on the enclosed questionnaire concerning the operation of your facilities. The data provided will be evaluated and translated into emissions of pollutants to the atmosphere and added to the total emissions from all sources in the State of North Dakota. This source information will enable the Department to develop air pollution control programs necessary for compliance with requirements of the Federal Clean Air Amendments of 1970.

This emission survey is being conducted under provisions of Section 23-25-04 of Chapter 23-25 of the North Dakota Century Code. Information from this survey will be used according to the confidentiality provision in Section 23-25-06 of Chapter 23-25 of the North Dakota Century Code or Section 114(c) of the Clean Air Amendments of 1970 concerning the divulgence of methods or processes entitled to protection as trade secrets.

If you require additional information or assistance regarding the questionnaire, you may contact Mr. Darwin W. Schultz of this office, telephone 224-2387. Some receiving the questionnaire may also be contacted by telephone by a representative of G.C.A., who is assisting this Department in the collection of emission inventory data.

We would appreciate the return of the questionnaire by May 7, 1971. Your cooperation and expeditious completion of the inventory forms is urgently requested.

Thank you.

Sincerely,

45

Gene A. Christianson

Gene A. Christianson, Director
Division of Environmental
Engineering

GAC:vb
Encl:

Health
Capitol Building
Bismarck, North Dakota - 58501

AIR CONTAMINANT EMISSIONS SURVEY

Information is to be representative of Calendar Year (Most recent)

First name: _____

Person to contact regarding this report: _____ Title: _____ Phone: _____

Mailing address: _____

Plant address: _____

Nature of business: (Products) _____

Employees at plant location: Less than 100 _____, 100 or more _____.

FUEL USE FOR GENERATION OF HEAT, STEAM, AND POWER

Normal operating schedule: _____ Hours per day _____ Days per week _____ Weeks per year

Seasonal and/or peak operation period: (Specify) _____

Estimate of percent of total fuel consumed to provide space heat: _____

A	B	C	D	E	F	G	H	I	J	K	L
Sources or No. of boilers[a]	Size of unit (input)[b], 10^6 Btu/Hr	Type unit[c]	Fuel data[d]					Air cleaning equipment		Estimate of contaminants[m]	
			Type fuel[e]	Amount per year[f]	Heat content[g], Btu	Percent sulfur[g,h]	Percent ash (coal only)[g,h]	Type[i]	Efficiency[j], %	Type[k]	Quantity[l]

[a] Multiple sources may be grouped if units burn the same fuel and are similar in size and type.
[b] Nameplate data are sufficient.
[c] Hand-fired; underfeed, traveling-grate or spreader stoker, cyclone furnace; pulverized, wet or dry bottom with or without fly ash reinjection; rotary or gun-type oil burner, etc.
[d] Fuel data are to be reported on an "as burned basis."
[e] Coke, bituminous coal, anthracite coal, No. 1, 2, 4, 5 or 6 fuel oil; natural gas; LPG; refinery or coke oven gas; wood, etc. (Also lignite coal.)
[f] Solid fuel, tons; liquid fuel, gallons, gaseous fuel, 100 cubic feet.
[g] If unknown, please give name and address of fuel supplier:
[h] Sulfur and ash content for each fuel should be a weighted average.
[i] Cyclone, scrubber, electrostatic precipitator, baghouse, settling chamber, etc.
[j] Please state if efficiency is a rated or operating efficiency.
[k] Fly ash, sulfur oxides, etc.
[l] Pounds or tons per year.
[m] Give stack test data if available, or otherwise specify basis used.

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Air Pollution Control
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

AIR CONTAMINANT EMISSIONS SURVEY
- REFUSE DISPOSAL

Refuse disposed of _____ On site _____ Off site - Location of disposal site and/or name of hauler: _____
Normal on-site combustion operating schedule: _____ Hours per day _____ Days per week _____ Weeks per year
Seasonal and/or peak operation period: (Specify) _____

A	B	C	D	E	F	G	H
Waste material						Estimate of contaminants[h]	
Type[a]	Amount per year[b]	Method of disposal (See code below)	Incinerator capacity, lb/hr	Auxiliary fuel used[c]	Type and efficiency, air cleaning equipment[d,e]	Type[f]	Quantity per year[g]

[a] Rubbish, garbage, mixed garbage and rubbish, waste paper, wood chips or sawdust, etc.
[b] Tons, pounds or gallons/year.
[c] Indicate whether auxiliary fuel is used in incinerators and pit burning, and the amount.
[d] Wetted baffles, impingement scrubbers, afterburners, electrostatic precipitator, baghouse, etc.
[e] Please state if efficiency is a rated or operating efficiency.
[f] Solids and/or gases (include chemical description of gases).
[g] Pounds or tons per year.
[h] Give stack test data if available, or otherwise specify basis used.

Method of Disposal Code:

1. Open-burning dump.
2. Sanitary landfill. (no burning)
3. Burned in boiler or furnace.
4. Incinerator, single chamber (one totally enclosed refractory-lined chamber in which both primary and secondary combustion take place).
5. Incinerator, multiple chamber (two or more refractory-lined chambers interconnected by gas passage ports or ducts and designed to provide complete combustion of materials.
6. Incinerator, rotary.
7. Conical metal burner.
8. Other (Specify)

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Health
Capitol Building
Bismarck, North Dakota - 58501

AIR CONTAMINANT EMISSIONS SURVEY

Information is to be representative of Calendar Year (Most recent)

First name: _____

Person to contact regarding this report: _____ Title: _____ Phone: _____

Mailing address: _____

Plant address: _____

Nature of business: (Products) _____

Employees at plant location: Less than 100 _____, 100 or more _____.

Normal operating schedule: _____ Hours per day _____ Days per week _____ Weeks per year.

Seasonal and/or peak operation period: _____

Note: For intermittent operations, indicate approximate frequency and duration so that estimates of yearly emissions may be obtained.

A	B	C	D	E	F	G	H
Processes or operations releasing contaminants to atmosphere[a,b]	Materials processed and/or used at operations		Quantity of gas discharged from process or operation	Type and efficiency air cleaning equipment[e,f]	Estimate of contaminants		Basis of estimate[h] (Please specify basis)
	Type[c]	Quantity per year[d]			Type[g]	Quantity per year[d]	

[a] Multiple sources may be grouped if units are similar in size and type.
[b] Sulfuric acid - chamber, aluminum smelting-crucible furnace, iron melting-cupola, cement manufacture - dry process, solvent cleaning, or other (please specify).
[c] Acid produced, tons, metal charged or processed, tons; cement produced, bbl.; solvent consumed, gallons; etc. per year. Specific quantities per year are not required if complete emission rate quantities are given in columns F and G.
[d] Pounds, tons, or gallons per year.
[e] Baghouse, electrostatic precipitator, cyclone, settling chamber, wet scrubber, etc.
[f] Please state if efficiency is a rated or operating efficiency.
[g] Dust, fume, gas, etc. emitted: iron oxide, mineral or rock dust, trichlorethylene, formaldehyde, sulfur dioxide, etc.
[h] Process material balance studies, field tests by plant or by equipment manufacturers, or other basis.

Any supplemental material or data considered pertinent (reports, summaries, test results, maps, flow diagrams) may be submitted with this form.

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QUESTIONNAIRE FOR GRAIN HANDLING OPERATION
DATA FOR YEAR (MOST RECENT)

OFFICE USE ONLY

Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____

Return to:

Air Pollution Control Program
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

I. General

A. Company Name _____

Plant Address _____

City _____ Zip Code _____

B. Person to Contact

Name _____

Position _____ Telephone No. _____

C. Average Number of Employees _____

D. Operating Schedule

_____ Hrs/Day (if seasonal, give range)

_____ Days/Year

II. Process Information

	Tons/Year
A. Terminal Elevators	
1. Shipping or Receiving	_____
2. Transferring, Conveying, etc.	_____
3. Screening and Clearing	_____
4. Drying	_____
B. Country Elevators	
1. Shipping or Receiving	_____
2. Transferring, Conveying, etc.	_____
3. Screening and Cleaning	_____
C. Grain Processing	
1. Alfalfa Dehydrating	_____
2. Alfalfa Meal Milling	_____
3. Corn Meal	_____
4. Soybean Processing	_____
5. Malted Barley or Wheat Cleaner	_____
6. *Milo Cleaner or Rice Dryer	_____
7. *Barley Flour or Rice Milling	_____
8. Wheat Milling	_____
D. *Feed Manufacturing	_____
E. Control Equipment	
1. Type of Dust Collector(s) (Specify separately for each process with emissions	_____
2. Design Efficiency	_____
3. Quantity Retained in collector(s), Tons/Year	_____

*Specify which kind.

ASPHALT BATCH PLANTS
DATA FOR YEAR (Most recent)

OFFICE USE ONLY

Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC No.: _____

Return to:

Air Pollution Control Program
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

I. General

A. Company Name _____

Plant Address _____

City _____ Zip Code _____

B. Person to Contact

Name _____

Position _____ Telephone No. _____

C. Average Number of Employees _____

_____ Hrs/Day (if seasonal, give range)

_____ Days/Year

I. Process Information

A. Amount of Asphalt Produced During Year _____ (Tons)

B. Control Equipment on Dryer

Equipment Type	% Efficiency	Installation Date
Precleaner		
Cyclone		
Scrubber		
Centrifugal		
Orifice Type		
Baffle Spray Tower		
Bag House		
Other		

C. Fuel Use

Type _____ Amount _____

CONCRETE BATCH PLANTS
DATA FOR YEAR (Most recent)

OFFICE USE ONLY

Return to:

Air Pollution Control Program
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

Rec'd by:_____
Reviewed by:_____
County:_____
Coordinates_____
SIC No.:_____

I. General

A. Company Name_____

Plant Address_____

City_____Zip Code_____

B. Person to Contact

Name_____

Position_____

Telephone No._____

C. Average Number of Employees_____

D. Operating Schedule

_____Hrs./Day (if seasonal, give range)

_____Days/Year

II. Process Information

A. Amount Produced During Year_____(tons) or_____(cubic yards)

B. Control Equipment

Type_____

Efficiency_____%

Installation Date_____

SAND AND GRAVEL
PROCESSING QUESTIONNAIRE
DATA FOR YEAR (MOST RECENT)

OFFICIAL USE ONLY

Return to:

Air Pollution Control Program
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

Rec'd by:_____
Reviewed by:_____
County:_____
Coordinates:_____
SIC No.:_____

I. General Information

A. Name of Firm_____

Plant Address_____City_____State_____

Mailing Address_____City_____State_____

B. Person to contact concerning this form_____

Telephone_____Position_____

C. Operating Schedule_____Hrs/day (if seasonal, give range)____

_____Days/yr

II. Process Information

A. Raw Material Processed_____Tons/yr

B. Amount Produced_____Tons/yr

C. Crushing Operations (Please Check)

1. Primary Crushing_____
2. Secondary Crushing and Screening_____
3. Tertiary Crushing & Screening_____
4. Fines Milling_____
5. Recrushing and Screening_____

D. Miscellaneous Operations (Please Check)

1. Screening_____
2. Conveying_____
3. Handling_____
4. Storing-Piles_____

III. Additional Process Information (Not described above)

IV. Stack Data

Source	Height	Diameter	Exit Velocity	Exit Temperature

V. Control Equipment

Operation	Type of Equipment	Percent Efficiency

North Dakota State Department of
Health
Capitol Building
Bismarck, North Dakota-58501

Reviewed by: _____
County: _____
Coordinates: _____ _____
SIC No.: _____

I. General Information

Firm Name _____

Person to Contact _____ Title _____ Telephone _____

Address of Plant _____ City _____

Mailing Address _____ City _____ Zip _____

Amount of Crude Processed _____ Barrels/Year. Plant Capacity _____ Barrels/Day.

Employees at Plant Site _____. Land Area at Site _____.

Normal Operating Schedule _____ Hours/Day _____ Days/Year.

Type of Sulfur Recovery System _____. Amount Removed _____. Method of Disposal _____.

II. Fuel Use for Generation of Heat, Power, Steam

A Source Number	B Size Unit (input) 10^6 BTU/Hr	C Instal-lation Date	D Type Fuel	E Amount Per/Year	F Heat Content	G Percent Sulfur	H Height Ft.	Stack Data		
								Dia Ft.	Exit Velocity fps	Exit Temp of

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Number	Releasing Contaminants To Atmosphere	Used at Operation		Control Equipment		
		Type	Quantity/Year	Type	Instal. Date	Efficiency
101	Catalytic Cracking Unit Type _____	Fresh Feed	_____ Barrels			
102	Colling Towers	Colling Water	_____ 10^6 Gals			
103	Vacuum Jets	Vacuum Feed	_____ Barrels			
104	Process Drains	Waste Water	_____ Barrels			
105	Compressor Int. Comb. Engines	_____ Gas	_____ 1000 $Ft.^3$			
106	Blowdown Systems	Emissions Will be Estimated from Plant Capacity				
107	Storage Tank Number Fixed Roof_____ Number Floating Roof_____	_____ 10^3 Gal _____ 10^3 Gal	Total Capacity _____ 10^3 Gal _____ 10^3 Gal			

IV. (a) Emission and Stack Information for above Processes

Source No. of Process Above	Check Type				Stack Data				Emission Estimates (Tons/Year) to Atmosphere						
	Stack	Flare	Tank Farm	Fugitive Loss	Height (Ft.)	Dia. (Ft.)	Exit Velocity (fps)	Exit Temp °F	Particulates	Sulfur Oxides	Carbon Monoxide	Hydrocarbon	Nitrogen Oxides	Other	Basis of Estimate

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Number	Process or Operation Releasing Contaminants to Atmosphere	Materials Processed and/or Used at Operation		Control Equipment		
		Type	Quantity/Year	Type	Instal. Date	Efficiency

IV. (b) Emission and Stack Information for Above Processes

Check Type					Stack Data				Emission Estimates (Tons/Year) to Atmosphere						
Source No. of Process Above	Stack	Flare	Tank Farm	Fugitive Loss	Height (Ft.)	Dia. (Ft.)	Exit Velocity (fps)	Exit Temp °F	Particulates	Sulfur Oxides	Carbon Monoxide	Hydrocarbon	Nitrogen Oxides	Other	Basis of Estimate

NOTE: 1. Any supplemental material or data considered pertinent (flow diagrams, plant layouts, emission tests or reports, etc.) should be submitted with this form.

2. Duplicate this or any page if more space is required.

SAWMILL EMISSION QUESTIONNAIRE
DATA FOR YEAR (MOST RECENT)

Return to: Air Pollution Control Program
North Dakota State Dept. of Health
Capitol Building
Bismarck, North Dakota - 58501

OFFICIAL USE ONLY
Rec'd by: _____
Reviewed by: _____
County: _____
Coordinates: _____
SIC No.: _____

I. General

A. Name of Company _____

Plant Address _____

City _____ State _____ Zip _____

B. Person to Contact _____ Position _____

Telephone No. _____

C. Operating Schedule _____ Hrs/Day _____ Days/Year

II. Process Information

A. Dust Producing Operations

1. Amount/Year (Tons) processed in each step:

Debarking _____

Cutting _____

Planing _____

Other _____

2. Is a burner used at this site? Yes____ No____

If yes, give amount burned/year (Tons)_____, and:

a. Date of Installation_____

b. Burner Data: Base Dia. (ft.)_____ Top Dia. (ft.)_____

Height (ft.)_____ Top Screen Size_____ Capacity____

c. Firing Data: % Excess Air_____ Exit Gas Temp. ^{o}F._____

Type Overfire - tangential or radial

Method of Charge - Bulldozer, conveyor, or other

d. Control Equipment: Type_____

Percent Efficiency_____% Date of Installation_____

APPENDIX C

LIST OF AREA SOURCE REFERENCES

1. "Sales of Natural Gas by Communities," Annual Report of Northern States Power Company to Public Service Commission, State of North Dakota, December 31, 1969.

2. "Sales of Natural Gas by Communities," Annual Report of Great Plains Natural Gas Co. to Public Service Commission, State of North Dakota, December 31, 1970.

3. "Monthly Operating Revenue Report - Gas," Report of Montana Dakota Utilities Co. to Public Service Commission, State of North Dakota, December 1970.

4. "Petroleum Products and Anti-Freeze 1968 Report," Bulletin No. 155, State Laboratories Department, North Dakota State Laboratories Commission, May 1969.

5. "Petroleum Products and Anti-Freeze, 1969 Report," Bulletin No. 158, State Laboratories Department, North Dakota State Laboratories Commission, May 1970.

6. "North Dakota Growth Indicators--1970-71," Business and Industrial Development Department, State of North Dakota.

7. Minerals Yearbook, 1968, Volume III, Area Reports: Domestic, Bureau of Mines, U.S. Department of the Interior.

8. "Motor Fuel Sales for 1970," memo from Olivia Miller, Director - Motor Fuel Tax Division, Office of State Tax Commissioner, State of North Dakota, March 16, 1970.

9. "North Dakota Traffic Report 1969," Planning and Research Division, North Dakota State Highway Dept.

10. "Basic Data Reduction - Community Description Reports," E. Lobb, Environmental Sanitation and Food, State Health Dept., North Dakota, 11 June 1968.

11. "Basic Data Reduction - Land Disposal Site Investigation Reports," E. Lobb, Environmental Sanitation and Food, State Health Dept., North Dakota, 12 June 1968.

12. Personal communication with Everett Lobb, Director, Environmental Sanitation and Food, State Department of Health, North Dakota, June 24, 1971.

13. "1970 Census of Population," North Dakota Advance Report (PC(V2)-36), Bureau of the Census, U.S. Department of Commerce, October 1970.

14. "Petroleum and Other Liquid Fuels," in Mark's Mechanical Engineers' Handbook, 6th ed., edited by Theodore Baumeister, McGraw-Hill Book Co., New York, N.Y., 1958.

15. Schedules of major airlines serving North Dakota; a) Frontier Airlines, b) North Central Airlines, and c) Northwest Airlines.

16. "Atmospheric Emissions from Fuel Oil Combustion - An Inventory Guide," Public Health Publication No. 999-AP-2, U.S. Dept. of Health, Education and Welfare, November 1962.

17. "Atmospheric Emissions from Coal Combustion - An Inventory Guide," National Air Pollution Control Administration Publication No. 999-AP-24, U.S. Dept. of Health, Education and Welfare, April 1966.

18. "North Dakota Air Pollution Control Regulations," Regulation No. 82, North Dakota State Department of Health, effective date: July 1, 1970.

19. "Air Pollutant Emission Inventory Techniques," by P.J. Bierbaum and M.J. Gedgaudas, draft manuscript, Office of Air Programs, Environmental Protection Agency.

20. "Air Pollutant Emission Factors," (Preliminary document), by M.J. McGraw and R.J. Duprey, Air Pollution Control Office, Environmental Protection Agency, April 1971.

21. "National Ambient Air Quality Standards," Federal Register 36, No. 67, 6680-6701, April 7, 1971.

22. "1971 Official Highway Map (North Dakota)," North Dakota State Highway Department.

23. "Petroleum Facts and Figures," 1971 edition, American Petroleum Institute, 1271 Avenue of the Americas, New York, N.Y.

24. Personal communication with Francis W. Schofield, U.S. Paint and Varnish Association, Washington, D.C., June 21, 1971.

25. "Bituminous Coal and Lignite Distribution-1970," Mineral Industry Surveys, Bureau of Mines, U.S. Dept. of the Interior, Washington, D.C.

26. "Sales of Fuel Oil and Kerosene in 1969," Mineral Industry Surveys, Bureau of Mines, U.S. Dept. of the Interior, Washington, D.C.

27. "1968 LP-Gas Shipments Up 11.7 Percent," in LP-Gas, p. 30, December 1969.

28. Personal communications with offices of railroads serving North Dakota: a) Burlington-Northern, b) SOO Line, and c) Chicago, Milwaukee, St. Paul and Pacific, July 7, 1971.

APPENDIX D

COMMERCIAL AIRCRAFT LANDING-TAKEOFF CYCLES IN NORTH DAKOTA (1971)

Airport	County	Aircraft Class	No. of Engine-LTO Cycles/yr.
Bismarck	Burleigh	Med. Range Turbofan	11,315
		Turboprop	2,920
Devils Lake	Ramsey	Turboprop	1,460
Fargo	Cass	Med. Range Turbofan	10,017
		Turboprop	2,920
Grand Forks	Grand Forks	Med. Range Turbofan	7,300
		Turboprop	3,650
Jamestown	Stutsman	Med. Range Turbofan	1,095
Minot	Ward	Med. Range Turbofan	2,920
		Turboprop	2,190
Williston	Williams	Turboprop	2,190